2. STOCK ASSESSMENT UPDATES

With the exception of Atlantic sharks, stock assessments for Atlantic HMS are conducted by ICCAT and the SCRS. Stock assessments were conducted during 2000 for North and South Atlantic albacore tuna, West Atlantic bluefin tuna, Atlantic yellowfin tuna, Atlantic blue marlin and Atlantic white marlin. For other HMS stocks, a brief review of the most recent assessment information and any new species-specific (primarily biological) studies with management implications are discussed. As established in the HMS FMP, a stock is considered overfished when the biomass level (B) falls below the minimum stock size threshold (MSST) and overfishing occurs when the maximum fishing mortality threshold (MFMT) exceeds the fishing mortality rate (F).

Table 2.1 Stock Assessment Summary Table.

Species	Current Relative Biomass Level	Minimum Stock Size Threshold	Current Fishing Mortality Rate	Maximum Fishing Mortality Threshold	Outlook
North Atlantic Swordfish	B_{99}/B_{MSY} = 0.65 (0.51 -1.05)	$0.8B_{MSY}$	F_{98}/F_{MSY} = 1.34 (0.84-2.05)	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring
South Atlantic Swordfish	B_{99}/B_{MSY} = 1.10 (0.84-1.40)	$0.8B_{MSY}$	F_{98}/F_{MSY} = 0.81 (0.47-2.54)	F_{year}/F_{MSY} = 1.00	Fully fished*; Overfishing may be occurring
West Atlantic Bluefin Tuna	SSB_{99}/SSB_{MSY}= 0.36 (low recruitment); 0.10 (high recruitment) SSB_{99}/SSB_{75} = 0.19 (low recruitment); 0.21 (high recruitment)	$0.86SSB_{MSY}$	F_{99}/F_{MSY} = 1.37 (low recruitment scenario) F_{99}/F_{MSY} = 2.22 (high recruitment scenario)	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring
East Atlantic Bluefin Tuna	SSB_{97}/SSB_{1970} = 0.19		Not estimated		Overfished; overfishing is occurring
Atlantic Bigeye Tuna	B_{98}/B_{MSY}=0.57-0.63	$0.6B_{MSY}$ (age 2+)	F_{98}/F_{MSY} = 1.50-1.82	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring

Species	Current Relative Biomass Level	Minimum Stock Size Threshold	Current Fishing Mortality Rate	Maximum Fishing Mortality Threshold	Outlook
Atlantic Yellowfin Tuna	B_{99}/B_{MSY} = 1.03	*$0.5B_{MSY}$ (age 2+)*	F_{99}/F_{MSY}= 0.88-1.16	F_{year}/F_{MSY} = 1.00	Stock not overfished; overfishing may be occurring
North Atlantic Albacore Tuna	B_{99}/B_{MSY} = 0.68 (0.52-0.86)	*$0.7B_{MSY}$*	$F_{99}F_{MSY}$ = 1.10 (0.99 - 1.30)	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring.
South Atlantic Albacore Tuna	B_{99}/B_{MSY} = 1.60 (0.01 - 1.98)		F_{99}/F_{MSY} = 0.57 (0.34-5.56)		Not overfished; overfishing not occurring *
West Atlantic Skipjack Tuna	unknown		unknown	F_{year}/F_{MSY} = 1.00	unknown
Atlantic Blue Marlin	B_{2000}/B_{MSY} = 0.4 (0.25 - 0.6)	*$0.9B_{MSY}$*	F_{99}/F_{MSY} = 4 (2.5 - 6)	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring.
Atlantic White Marlin	B_{2000}/B_{MSY} = 0.15	*$0.85B_{MSY}$*	F_{99}/F_{MSY} > 7	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring.
West Atlantic Sailfish	B_{92-96}/B_{MSY} = 0.62	*$0.75B_{MSY}$*	F_{91-95}/F_{MSY} = 1.4	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring.
Blacktip Shark	N_{98}/N_{MSY}=0.50 (baseline) N_{98}/N_{MSY}=0.48 (alternative)	*$0.9B_{MSY}$*	F_{97}/F_{MSY} = 3.52 (baseline) F_{97}/F_{MSY} = 3.74 (alternative)	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring.
Sandbar Shark	N_{98}/N_{MSY}=0.58 (baseline) N_{98}/N_{MSY}=0.70 (alternative)	*$0.9B_{MSY}$*	F_{97}/F_{MSY} = 2.70 (baseline) F_{97}/F_{MSY} = 1.62 (alternative)	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring
Large Coastal Sharks (all species)	N_{98}/N_{MSY}=0.30 (baseline) N_{98}/N_{MSY}=0.36 (alternative)	*$0.9B_{MSY}$*	F_{97}/F_{MSY} = 6.34 (baseline) F_{97}/F_{MSY} = 6.03 (alternative)	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring
Small Coastal Sharks	B_{91}/B_{MSY} = 1.12	*$0.9B_{MSY}$*	F_{86-91}/F_{MSY} = 0.89	F_{year}/F_{MSY} = 1.00	Stock not overfished; overfishing is not occurring

Species	Current Relative Biomass Level	Minimum Stock Size Threshold	Current Fishing Mortality Rate	Maximum Fishing Mortality Threshold	Outlook
Pelagic Sharks	unknown	unknown	unknown	unknown	unknown

*South Atlantic swordfish, South Atlantic albacore and East Atlantic bluefin tuna are not found in the U.S. EEZ and, therefore, not managed under the Magnuson-Stevens Act.

2.1 Stock Assessment Update: ATLANTIC SWORDFISH

2.1.1 Life History/Species Biology Information

In support of monitoring the swordfish stock status in a way that explicitly accounts for the sexually dimorphic growth of swordfish, analyses of catch rate patterns which make use of the sex-specific age slicing algorithms used in the 1999 stock assessment were conducted (SCRS/00/144). Swordfish catch, size and catch rate patterns through 1999, based on fishermen logbook reports and observer data, were examined in support of monitoring the recovery of North Atlantic swordfish. U.S. catch rates from the pelagic longline fleet indicate a somewhat improved condition in 1999 compared to earlier years.

Atlantic swordfish are currently managed as two separate stocks, as divided by a line designated for management purposes at 5 degrees North latitude. In 1999, ICCAT adopted a resolution to support research programs to reduce the current uncertainties about the structure, mixing, and boundaries of stocks.

Research on the genetics of swordfish in the Atlantic was continued although no manuscript on the topic was presented to the 2000 SCRS. The analysis conducted by investigators from the FISHTEC consortium has provided genetic evidence in support of the hypothesis that swordfish from the Northwest Atlantic are genetically distinct from those found in the South Atlantic. Genetic variation in introns of the nuclear genes aldolase B (aldB) and the lactate dehydrogenase A (ldhA) was examined and the distribution of alleles was found to be significantly different in samples from the two regions. These results are consistent with those obtained from earlier studies of mitochondrial DNA. Taken together these results provide support for the current practice of dividing the North and South Atlantic into separate management units for swordfish.

2.1.2 Recent Stock Assessment Results

In 1999, assessments for the north Atlantic stock indicated that the decline in biomass has been slowed or arrested (1999a). In addition, the SCRS concluded that estimated high recruitment in 1997 and 1998 could promote improvement in future spawning stock biomass, if these year classes are not heavily harvested. Updated indices examined in 2000 confirmed that a positive effect from this strong recruitment has already been manifested in younger ages and in the biomass indices. The replacement yield for the year 2000 was estimated to be about 11,700 mt. Catches in 1999 slightly exceeded this level, although only catches below replacement yield are likely to allow the stock to recover.

The SCRS also conducted an assessment of the South Atlantic swordfish stock in 1999. Constant catch in the South Atlantic is expected to result in a continued gradual reduction in biomass; the expected levels of decline and the associated timing vary between models. Fishing mortality is likely to continue to increase gradually and reach F_{MSY} in 2006. There is a good deal of uncertainty surrounding the projection results due to ambiguity in the catch-per-unit-effort (CPUE) trend for the non-target fisheries.

In preparation for future swordfish assessments, the SCRS has suggested a number of initiatives to improve CPUE indices. Methodological problems for the bycatch series must be addressed. The selectivities of deep and shallow longline sets should be investigated and compared. Finally, scientists should explore ways to more directly take into account the environment and habitat.

2.1.3 SCRS Advice and Current Management Measures

The SCRS cautioned that the north Atlantic recovery plan is very sensitive to any overharvests. If recent overharvests of 10% continue, the stock would likely not have a greater than 50% probability of reaching biomass levels that will support MSY. In 2000, Japan reported that it had seriously exceeded its North Atlantic swordfish quota for the last few years despite some actions taken to address this compliance problem. Because of concerns for the integrity of the 10 year swordfish rebuilding program adopted by ICCAT in 1999 and given the recent underharvest by the United States of its North Atlantic swordfish quota, the United States, with the full support of the U.S. longline industry, agreed to assist Japan in addressing its swordfish overharvest. Specifically, a measure was adopted that, among other things, will allow Japan access to 400 mt of unused U.S. quota for 2001 only. ICCAT also continued its efforts to control illegal, unregulated and unreported (IUU) fishing activities, with an agreement to develop a statistical document program for swordfish. This new program will monitor harvest and trade, and assist in the collection of data. Together, these steps are designed to ensure that total catches do not exceed the total allowable catch (TAC) established by the 1999 rebuilding program.

Relative to the South Atlantic, the SCRS expressed concern with a pattern of high catches and declining CPUE trends in some of the bycatch fisheries used in 1999 as indicators of swordfish abundance. With the total allowable catch of 14,620 mt that was adopted for 2001, there is a greater than 50% chance of biomass declining to levels slightly below the level that would support MSY. Moreover, unlike past years, no member specific quotas were agreed for this fishery. The SCRS recommended that future catch levels should remain at the 1998 level (i.e., 13,500 mt) in order to keep the stock at about the biomass level that would support MSY.

Table 2.1.1 **Summary Table for the Status of Atlantic Swordfish Stocks**. Source: SCRS, 2000, unless otherwise indicated.

Stock (2 stocks; divided at 5°N. Lat.)	**North Atlantic**	**South Atlantic**
Age/size at Maturity	Females: 50% are mature ~ 179 cm lower jaw fork length (LJFL) (5 years) Males: 50% are mature ~ 129 cm LJFL (Arocha, 1997)	
Spawning Sites	Warm tropical and sub-tropical waters (throughout the year)	
Current Relative Biomass Level (B_{1999}/B_{MSY}) *Minimum Stock Size Threshold*	0.65 (0.51-1.05) $0.8B_{MSY}$	1.10 (0.84-1.40) $0.8B_{MSY}$
Current Fishing Mortality Rate F_{1998}/F_{MSY} *Maximum Fishing Mortality Threshold*	1.34 (0.84-2.05) $F_{1998}/F_{MSY} = 1.00$	0.81 (0.47-2.54) $F_{1998}/F_{MSY} = 1.00$
Maximum Sustainable Yield	13,370mt (7,625 - 15,900mt)	13,650 mt (5,028 - 19,580 mt)
Current (1999) Yield	11,914 mt	15,463 mt
Current (2000) Replacement Yield	11,720 mt (6,456 - 15,040 mt)	14,800 mt (5,328 - 16,240 mt)
Outlook	Overfished; overfishing continues to occur	Fully fished*; Overfishing probably continues to occur

*South Atlantic swordfish are not found in the U.S. EEZ and, therefore, not managed under the Magnuson-Stevens Act. The classification of the stock as fully fished is based on the definitions established in the HMS FMP and is for descriptive purposes only.

2.2 Stock Assessment Update: ATLANTIC BLUEFIN TUNA

2.2.1 Life History/Species Biology Information

Basic information on the life history of west Atlantic bluefin tuna can be found in the HMS FMP (Sections 2.2.1 and 6.3.1.3). There are numerous research projects underway regarding the life history of west Atlantic bluefin tuna.

As part of its commitment to ICCAT's Bluefin Year Program, research supported by the United States has concentrated on ichthyoplankton sampling, reproductive biology, methods to evaluate hypotheses about movement patterns, spawning area fidelity and stock structure investigations. Ichthyoplankton surveys in the Gulf of Mexico during the bluefin spawning season were continued in 1999 and 2000. Data resulting from these surveys which began in 1977 are used to develop a fishery-independent abundance index of spawning west Atlantic bluefin tuna. This index has continued to provide one measure of bluefin abundance that is used in SCRS assessments of the status of the resource.

Studies related to genetic evaluations of the number of fishery management units of Atlantic bluefin are being conducted at several laboratories in the United States. The NOAA laboratory in Charleston, S. C., is acting as a sample archive center and has tissues from all bluefin collected for stock structure research by NMFS since 1996 and some or all samples collected by researchers from various institutions including the University of South Carolina, the Virginia Institute of Marine Science, the University of Maryland, Texas A&M University, and the Massachusetts Department of Marine Fisheries (SCRS/00/145). Progress was reported on a study of the genetic composition of 127-190 and 197-277 cm bluefin captured in the west Atlantic and bluefin from multiple year classes caught in the Mediterranean (SCRS/00/147). Results from that work generally indicated that differences in genetic frequencies were primarily within regions rather than between regions; it also indicated that there could be differences between year class within the Mediterranean.

Scientists from NMFS, Texas A&M University and University of Maryland continued research on the feasibility of using otolith microconstituents to distinguish bluefin stocks. Interlaboratory comparison of Atlantic bluefin tuna otoliths were conducted between U.S. and Canadian laboratories. Results were well within acceptable levels; apart from one element (Mn), differences between labs were relatively minor (generally <6% for four elements and for the two elements for which differences exceeded 5% the abundances of the elements were low and the relative abundances were similar between the labs). Preliminary analyses comparing age 1 bluefin from the west Atlantic and the Mediterranean collected in 1998 indicated good separation (67-89% correctly classified depending on the approach used). Only two age zero fish were collected in the west in 1998, so a statistical comparison of age-0 western Atlantic vs. Mediterranean was not attempted.

Otolith chemistry of age-0 ABT was determined for individuals from several locations (Alboran Sea, Tyrrhenian Sea, Ionian Sea, Ligurian Sea) within the Mediterranean; samples from both 1998 and 1999 were assayed to examine spatial and temporal stability. Otolith signatures from different regions were relatively similar while signatures from similar regions did vary among years suggesting that shifts in ambient water chemistry may be important. Otolith chemistry of juvenile bluefin tuna was measured to assess differences in composition among nursery areas in the western Pacific: East China Sea, Sea of Japan, and Pacific Ocean. Various analyses of bluefin tuna collected in 1994 and 1995 indicated concentrations of four elements (Na, Mg, Mn, Sr) differed among nurseries. Temporal stability of the elemental fingerprint was examined over a three-year period (1995-1997) in the East China Sea. Significant interannual trends were observed for Na, Mg, and Ba; however, differences in elemental fingerprints among nurseries were greater than temporal variability within a nursery. Efforts to obtain samples both in the west Atlantic and the Mediterranean regions continue.

Research on bluefin tuna movement patterns using tags was continued in 1999 and 2000. For bluefin tuna, the longest movement during 1999 (4,247 NM) was from a fish released off Hatteras, N.C. (35° 13' N, 75° 42' W) and recovered off Madeira Islands (Portugal) (14° 8' N, 34° 58' W) 857 days later. Electronic tagging activities also continued off North Carolina (scientists from Stanford University, the Monterey Bay Aquarium and NMFS) and off northeast North America (by scientists from (1) the New England Aquarium, Massachusetts Division of Marine Fisheries and DFO from Canada and (2) Stanford University and the Monterey Bay Aquarium). Additionally researchers from Stanford University and the Monterey Bay Aquarium continued studying the feasibility of tagging bluefin tuna in the Gulf of Mexico in 1999 and 2000 successfully releasing four bluefin with electronic tags in 1999 and about ten fish in 2000.

A summary of pop-up satellite tagging of giant bluefin tuna in the joint US-Canadian program in the Gulf of Maine and Canadian Atlantic was reported by Lutcavage et al. (SCRS/00/95). Since 1997, 58 singlepoint and 21 light-sensing pop-up archival satellite tags (Microwave Telemetry, Inc., Columbia, MD) have been deployed on giant bluefin tuna (178-266 cm SFL) in the western North Atlantic. The goals of the initial deployments were to test external tag attachments and the tags themselves, which evolved to include greater data logging capacity, additional sensors, and increased power. All of the tags were deployed on fish from New England and Canadian commercial or charter fishing vessels (harpoon, rod and reel, trap, and purse seine gear) using tag attachment techniques developed by the U.S. fishermen (authors Murray, Chaprales, Mendillo, and Genovese). Attachment periods ranged from 5 - 365 days, although the majority of tags detached from the fish over the presumed spawning period (April-July). Tag reporting success rates were 59% for single point tags and 79% for the archival tags.

Data successfully returned from the archival tags will generate geolocation estimates and errors associated with light-derived data. Plans are now in place to deploy pop-up archival tags for 365-500 day attachments. The success of the long-term attachment of the tags enables such questions as spawning site fidelity to be addressed. Some of the discussion focused on the importance of understanding the methods of calculating geolocation, a topic that has recently been addressed at international tagging meetings (see SCRS/00/123).

A workshop on the biology of bluefin in the central Atlantic was held in May 2000 under the sponsorship of the East Coast Tuna Association and the Bermudian government. Electronic tagging results indicated the presence of large, presumably adult bluefin in the north Sargasso Sea during periods when spawning occurs in the Gulf of Mexico and the Mediterranean Sea raising questions about what they are doing there. A multi-faceted research expedition was recommended (SCRS/00/125).

Research to support assessments and on assessment methods continued. U.S. scientists participated in the SCRS Assessment Methods Meeting in May 2000 and submitted three papers on assessment methods. U.S. scientists also participated in the Meeting of the Ad Hoc GFCM/ICCAT Working Group held in Malta and the west Atlantic bluefin working group meeting held in Madrid in September 2000. U.S. scientists presented fourteen papers at that meeting on genetic analyses and tagging results, on basic statistics and indices of abundance and on assessment methods.

2.2.2 Recent Stock Assessment Results

The two management units for Atlantic bluefin tuna are separated at 45° W above 10° N and at 25° W below the equator, with an eastward shift in the boundary between those parallels. The 2000 assessment of the west Atlantic stock included projections for two scenarios about future recruitment (Table 2.2.1). One scenario assumed that future recruitment will approximate the average estimated recruitment since 1976, unless spawning stock size declines to low levels. The second scenario anticipated an increase in recruitment corresponding to the increase in spawning stock size up to a maximum level no greater than the average recruitment for 1970 - 1974. These scenarios were referred to as the low recruitment and high recruitment scenarios, respectively.

The results of projections based on the low recruitment scenario (Table 2.2.2) indicated that a constant catch of 3,000 mt per year has about a 75% probability of allowing rebuilding to the associated B_{MSY} level by 2018. A constant catch of 2,500 mt per year has about a 56% probability of allowing rebuilding to the 1975 stock size by 2018. Under the high recruitment scenario, a constant catch of about 3,000 mt has about a 62% probability of allowing rebuilding to the 1975 stock size, and with a constant annual catch of 2,500 mt there is about a 47% chance of rebuilding to the associated B_{MSY} by 2018. The SCRS cautioned that these conclusions do not capture the full degree of uncertainty in the assessments and projections. The immediate rapid projected increases in stock size are strongly dependent on estimates of high levels of recent recruitment, which are the most uncertain part of the assessment. The implications of stock mixing between the east and west Atlantic add to the uncertainty.

The SCRS has noted that significant improvements to the biological knowledge of bluefin tuna are required before an improved assessment of west Atlantic bluefin can be achieved. Accumulating evidence, including recent tagging results, shows that the populations of fish in the western and eastern management units are somewhat related. There is a need to study the best proxy for MSY, and to increase the accuracy on estimation of recruitment levels. The SCRS has suggested a workshop to address the effects and relationship between environment and recruitment, and how these relationships could best be reflected in stock assessments.

The SCRS was unable to update the assessment for the east Atlantic and Mediterranean stock in 2000, due to increased under-reporting and a lack of CPUE and size data. The 1998 projections (Table 2.2.3) show that current catch levels are not sustainable. A catch of 25,000 mt would halt the decline in spawning stock biomass in the medium term, but reported catches in 1999 totaled over 34,000 mt. In addition, the SCRS expressed continued concern about the intensity of fishing pressure on small fish. This contributes substantially to growth over-fishing, and it seriously reduces the long-term potential yield from the resource.

2.2.3 SCRS Advice and Current Management Measures

Relative to the west Atlantic stock, the SCRS concluded that in light of uncertainty in the assessment (particularly with regard to estimates of recent high recruitment), the total allowable catch should not be changed significantly from the level established by the 1998 rebuilding program (i.e., 2500 mt). Based on this advice, ICCAT did not adopt any changes to the 20 year rebuilding program at its 2000 meeting.

Despite SCRS advice that current catch levels in the east Atlantic and Mediterranean are unsustainable, the total allowable catch was not reduced at the 2000 ICCAT meeting. Unless significant management actions are taken to reverse these trends, the poor condition of the east Atlantic stock and fishery may adversely affect recovery of the bluefin tuna stock in the west Atlantic. At its 2000 meeting, ICCAT adopted a recommendation to support bluefin tuna research in the central north Atlantic. A separate resolution calls for the SCRS to hold an intersessional meeting to examine the effects of mixing for stock assessments and management. This resolution requests the SCRS to consider the appropriateness of the current boundary between the western and eastern management units for Atlantic bluefin tuna and to develop recommendations regarding future management strategies that take mixing into account.

Table 2.2.1 Summary Table for the Status of West Atlantic Bluefin Tuna

Age/size at Maturity	Age 8/~ 200 cm fork length
Spawning Sites	Primarily Gulf of Mexico and Florida Straits
Current Relative Biomass Level *Minimum Stock Size Threshold*	SSB_{99}/SSB_{75} (low recruitment) = .19 (.12-.31) SSB_{99}/SSB_{75} (high recruitment) = .21 (.12-.33) SSB_{99}/SSB_{msy} (low recruitment) = .36 (.28-.49) SSB_{99}/SSB_{msy} (high recruitment) = .10 (.06-.14) $0.86B_{MSY}$
Current Relative Fishing Mortality Rate *Maximum Fishing Mortality Threshold*	F_{99}/F_{MSY} (low recruitment) = 1.37 (0.96-1.87) F_{99}/F_{MSY} (high recruitment) = 2.22 (1.51-3.32) $F/F_{MSY} = 1.00$
Maximum Sustainable Yield	Low recruitment scenario: 3,500 mt (3,200-3,800) High recruitment scenario: 7,700 mt (6,100-9,600)
Current (1999) Yield	2,771
Short Term Sustainable Yield	Probably > 3,000 mt
Outlook	Overfished; overfishing continues to occur

Table 2.2.2 Probability of western Atlantic bluefin tuna achieving rebuilding target by 2018. From SCRS, 2000.

Catch (mt)	Low Recruitment Scenario B/B_{MSY}	High Recruitment Scenario B/B_{MSY}
500	100%	86%
1000	100%	79%
1500	100%	71%
2000	100%	62%
2300	99%	53%
2500	94%	47%
2700	86%	43%
3000	75%	36%

Table 2.2.3 Summary Table for the Status of East Atlantic Bluefin Tuna

Age/size at Maturity	Age 4-5
Spawning Sites	Mediterranean Sea
Current Relative Biomass Level	$SSB_{97}/SSB_{1970} = 0.19$
Current Relative Fishing Mortality Rate	Not estimated
Maximum Sustainable Yield	Not estimated
Current (1999) Yield	31,487 mt
Sustainable Yield (1997)	about 25,000 mt
Outlook	Overfished; overfishing continues to occur

2.3 Stock Assessment Update: BAYS TUNAS

2.3.1 ATLANTIC BIGEYE TUNA

2.3.1.1 Life History/Species Biology Information

Information on the life history of Atlantic bigeye tuna can be found in the HMS FMP (Sections 2.2.1 and 6.3.1.2). In 2000, ICCAT's Bigeye Tuna Year Program facilitated a number of research activities, including conventional tagging in the Azores and Canary Islands. A tagging manual was prepared and distributed to the National Laboratories. Contacts were also maintained to pursue genetic studies and archival tag deployment. These activities will continue in 2001.

2.3.1.2 Recent Stock Assessment Results

ICCAT currently manages Atlantic bigeye tuna based on an Atlantic-wide single stock hypothesis. However, the possibility of other scenarios, including north and south stocks, does exist, and should not be disregarded (SCRS, 1999b). The SCRS completed a stock assessment of Atlantic bigeye tuna in October 1999. The assessment utilized catch and effort information submitted by ICCAT member and non-member nations. One important component of the 1999 bigeye tuna assessment was the incorporation of revised data from previous years. This resulted in the addition of some 20,000 mt of previously unreported catch.

Work is being carried out on an integrated statistical model appropriate to the assessment of tropical tuna species. In the meantime, the SCRS has recommended that the assessment of the bigeye stock planned for 2001 should not be carried out. Instead, a tropical tuna statistics group will meet during the week prior to the 2001 SCRS to revise the databases for three species of tropical tunas (bigeye, yellowfin and skipjack) in depth, and develop criteria for the validation of statistics. These criteria could then be incorporated into the new ICCAT data base to support future assessments of tropical tunas, including bigeye.

2.3.1.3 SCRS Advice and Management Measures

Catch of undersized fish remains a major problem in the Atlantic bigeye tuna fishery. The share of bigeye tuna less than the ICCAT minimum size (3.2 kg) is approximately 55 percent, by number, of all bigeye tuna harvested. This number has stabilized since with the time/area closure for purse seining in the eastern tropical Atlantic area, but still remains a concern (SCRS, 1999b). SCRS has recommended a reduction of catch to approximately 80,000 mt to prevent further decline of the stock, although an additional reduction of catch would be required to rebuild the stock to MSY levels. At its 2000 meeting, ICCAT adopted a recommendation that establishes the first-ever total allowable catch for bigeye tuna. While the measures adopted will not be sufficient to rebuild the stock, catches should be reduced significantly from the 1999 level of 120,883 mt, as a first step toward rebuilding.

Table 2.3.1 Summary Table for the Status of Atlantic Bigeye Tuna

Age/size at Maturity	Age 3/~100 cm curved fork length
Spawning Sites	Tropical waters
Current Relative Biomass Level *Minimum Stock Size Threshold*	B_{98}/B_{MSY} = 0.57 - 0.63 $0.6B_{MSY}$ (age 2+)
Current Relative Fishing Mortality Rate *Maximum Fishing Mortality Threshold*	F_{98}/F_{MSY} = 1.50 - 1.82 F_{year}/F_{MSY} = 1.00
Maximum Sustainable Yield	79,000 - 94,000 mt
Current (1999) Yield	121,000 mt
Current (1999) Replacement Yield	72,000 - 85,000 mt
Outlook	Overfished; overfishing is occurring

2.3.2 ATLANTIC YELLOWFIN TUNA

2.3.2.1 Life History/Species Biology Information

The HMS FMP (Sections 2.2.1 and 6.3.1.5) includes summary information on the life history of yellowfin tuna. In 2000, scientists from the United States and Venezuela continued their cooperative research on the spawning status and maturity of yellowfin tuna in the western central Atlantic (SCRS/00/46). Cooperative research with Mexico was continued, with joint analyses of longline observer program data from the Gulf of Mexico and the calculation of abundance indices (SCRS/00/67). Tagging and recapture research continued for yellowfin tuna. There was a trans-Atlantic yellowfin tuna recapture, released off Cape Hatteras, N.C. (38° 10' N, 74° 10' W) and recaptured off the Bay of Biscay, near Spain (34° N, 4° W), a distance of about 3,106 NM, in 779 days.

U.S. scientists also calculated yellowfin tuna abundance indices using data from the U.S. rod and reel fishery off the U.S. coast from Virginia through Massachusetts (SCRS/00/64) as well as from logbook data reported by the U.S. longline fleet (SCRS/00/65). Yellowfin tuna tag-releases and recaptures from the U.S. Cooperative Tagging Center Program are reviewed in SCRS/00/66.

A study analyzing the genetic variability in bigeye and yellowfin larvae taken in the Gulf of Guinea, of the west coast of Africa, began in September 2000. This Texas A&M project, funded by the Saltonstall-Kennedy grant program (NA97FD0553), will examine mitochondrial and nuclear DNA loci to determine whether the genetic variation observed in a single sample is representative of that found in the adult population. Also, samples obtained at different seasons or in successive years will be compared to determine seasonal and temporal variations. The results will be used to develop a monitoring scheme for the assessment of tuna reproduction in the Gulf of Guinea.

2.3.2.2 Recent Stock Assessment Results

Based on movement patterns, as well as other information (e.g., time-area size frequency distributions and locations of fishing ground), ICCAT currently manages Atlantic yellowfin tuna based on an Atlantic-wide single stock hypothesis. The SCRS conducted a new stock assessment for Atlantic yellowfin tuna in 2000 using various age-structured and production models (SCRS 2000). Both equilibrium and non-equilibrium production models were examined. The data used for the equilibrium models assumed a fixed increase in fishing power of 3% per year. In contrast, the non-equilibrium model estimated changes in fishing power trends internally by fleet.

The production model analyses imply that although catches could be slightly lower than MSY levels, effort may be either above or below the MSY level, depending on assumptions about changes in fishing power. Consistent with these results, yield-per-recruit analyses also indicate that current fishing mortality rates (1999) could either be above, or about at, levels that could produce MSY. In summary, reported yellowfin landings appear to be close to the MSY level and fishing effort and fishing mortality may be in excess of the levels associated with MSY.

2.3.2.3 SCRS Advice and Management Measures

The SCRS continues to recommend that fishing mortality on small yellowfin should be reduced. Based on the results of the 2000 assessment, the SCRS reaffirmed its support for the Commission's 1993 recommendation that there be no increase in the level of effective fishing effort exerted on Atlantic yellowfin tuna over the level observed in 1992.

A number of management measures have been implemented in the United States, consistent with this advice, to prevent overfishing. In 1999, NMFS implemented limited access in the pelagic longline fishery for Atlantic tunas, as well as a recreational retention limit for yellowfin tuna. The United States has also implemented a higher minimum size than that required by ICCAT. This species has not been listed as overfished, thus no rebuilding program has been adopted at this time.

Table 2.3.2 Summary Table for the Status of Atlantic Yellowfin Tuna

Age/size at Maturity	Age 3/~110 cm curved fork length
Spawning Sites	Tropical waters
Current Relative Biomass Level *Minimum Stock Size Threshold*	B_{97}/B_{MSY} = 1.03 $0.5B_{MSY}$ (age 2+)
Current Relative Fishing Mortality Rate F_{1999}/F_{MSY} *Maximum Fishing Mortality Threshold*	F_{97}/F_{MSY} = 0.88 - 1.16 F_{year}/F_{MSY} = 1.00
Maximum Sustainable Yield	144,600 - 152,200 mt
Current (1999) Yield	140,000
Current (1999) Replacement Yield	May be close to current yield
Outlook	Stock not overfished, overfishing may be occurring

2.3.3 ATLANTIC ALBACORE TUNA

2.3.3.1 Life History/Species Biology Information

No new life history information is available regarding Atlantic albacore tuna. Please refer to the HMS FMP (Sections 2.2.1 and 6.3.1.4) for more information.

2.3.3.2 Recent Stock Assessment Results

On the basis of the available biological information, the existence of three stocks of albacore tuna is assumed for assessment and management purposes; northern and southern Atlantic stocks (separated at 5° N) and a Mediterranean stock. U.S. fishermen caught relatively small amount of albacore from theNorth Atlantic stock/management unit, as well as minor catches of South Atlantic albacore.

The SCRS conducted new stock assessments for North and South Atlantic albacore tuna in 2000. Results of the North Atlantic assessment were consistent with previous findings. Equilibrium yield analyses indicate that current spawning stock biomass is about 30% below that associated with MSY. However, there are considerable uncertainties associated with the estimates of current biomass relative to the biomass associated with MSY (B_{MSY}), due to difficulty in estimating how recruitment might decline below historical levels of stock biomass.

In the south Atlantic, the spawning stock biomass of the albacore stock appears to have declined substantially relative to the late 1980s, but the decline may have leveled off in recent years. After the 2000 assessment, the SCRS concluded that the recent level of south Atlantic albacore landings can probably be maintained into the near future without causing a substantial decline in spawning stock biomass.

2.3.3.3 SCRS Advice and Management Actions

Relative to the north Atlantic, the SCRS concluded that to maintain a stable spawning stock biomass in the near future, catch should not exceed the current catch level (34,500 mt) in the period 2001-02. In order to begin increasing towards the level estimated to support MSY, catches of North Atlantic albacore would need to be reduced to less than 31,000 mt. In 1998, parties agreed to limit the number of vessels fishing for Northern albacore to the average number in the period 1993-95. The SCRS has since noted that effort limitations are likely to be ineffective for this stock, and recommended that a catch limit be established. In 2000, ICCAT adopted a recommendation that sets a total allowable catch at 34,500 mt for the year 2001.

Table 2.3.3 Summary Table for the Status of North Atlantic Albacore Tuna

Age/size at Maturity	Age 5/~90 cm curved fork length
Spawning Sites	Subtropical western waters of the Northern Hemisphere
Current Relative Biomass Level *Minimum Stock Size Threshold*	B_{99}/B_{MSY} = 0.68 (0.52 - 0.86) $0.7B_{MSY}$
Current Relative Fishing Mortality Rate *Maximum Fishing Mortality Threshold*	F_{99}/F_{MSY} = 1.10 (0.99 - 1.30) $F_{year}/F_{MSY} = 1.00$
Maximum Sustainable Yield	32,600 mt [32,400 - 33,100 mt]
Current (1999) Yield	34,557 mt
Current Replacement Yield	not estimated
Outlook	Overfished; overfishing is occurring

Table 2.3.4 Summary Table for the Status of South Atlantic Albacore Tuna

Age/size at Maturity	Age 5/~90 cm curved fork length
Spawning Sites	Subtropical western waters of the Southern Hemisphere
Current Relative Biomass Level	B_{99}/B_{MSY} = 1.60 (0.01 - 1.98)
Current Relative Fishing Mortality Rate	F_{99}/F_{MSY} = 0.57 (0.34 - 5.56)
Maximum Sustainable Yield	30,200 mt (50 - 31,400)
Current (1999) Yield	27,293 mt

Current Replacement Yield	29,200 mt (12,10 - 31,400)
Outlook	Not overfished; overfishing is not occurring

2.3.4 WEST ATLANTIC SKIPJACK TUNA

2.3.4.1 Life History/Species Biology Information

No new life history information is available regarding Atlantic skipjack tuna. Please refer to the HMS FMP (Sections 2.2.1 and 6.3.1.4) for more information on the life history of skipjack tuna.

2.3.4.2 Most Recent Stock Assessment Data

The stock structure of Atlantic skipjack tuna is not well known, and two management units (east and west) have been established due to the development of fisheries on both sides of the Atlantic and the lack of transatlantic recoveries of tagged skipjack tuna. U.S. vessels fish on the west Atlantic stock/management unit.

The characteristics of Atlantic skipjack tuna stocks and fisheries make it extremely difficult to conduct stock assessments using current models. Continuous recruitment occurring throughout the year, but heterogeneous in time and area, makes it impossible to identify and monitor individual cohorts. Apparent variable growth between areas makes it difficult to interpret size distributions and their conversion to ages. For these reasons, SCRS did not conduct a stock assessment for Atlantic (west or east) skipjack tuna in 1999, although some estimates of current yield were made (SCRS, 1999b).

Table 2.3.5 Summary Table for the Status of West Atlantic Skipjack Tuna

Age/size at Maturity	Age 1 to 2/~50 cm curved fork length
Spawning Sites	Opportunistically in tropical and subtropical waters
Current Relative Biomass Level *Minimum Stock Size Threshold*	unknown unknown
Current Relative Fishing Mortality Rate F_{1998}/F_{MSY} *Maximum Fishing Mortality Threshold*	unknown $F_{year}/F_{MSY} = 1.00$
Maximum Sustainable Yield	not estimated
Current (1999) Yield	27,043 mt

Current (1999) Replacement Yield	not estimated
Outlook	unknown

2.4 Stock Assessment Update: ATLANTIC BILLFISH

2.4.1 Life History/Species Biology Information

A summary of life history information is provided in the Billfish Amendment in Section 3.1.1 and Chapter 4. U.S. scientists prepared a number of scientific documents for the Fourth ICCAT Billfish Workshop, held in Miami, USA in July 2000. Document SCRS/00/54 discussed the analyses of blue marlin and white marlin stock structure using mitochondrial DNA, single copy nuclear DNA, and microsatellite DNA to survey variation across large samples of both species. The levels of variation revealed by the different molecular methodologies varied between species and molecular markers, and were quite high for both mtDNA and the microsatellite loci. Analysis of samples from the same location taken in different years did not reveal significant spatial heterogeneity and allowed researchers to pool temporal samples to increase the power of spatial analyses. No significant spatial heterogeneity in the distribution of allelic variants were found for any of the molecular markers. The genetic results are consistent with the natural history of both species--their continuous distribution across the tropics, broad spawning times and areas, and high vagility as adults--and support the hypothesis that blue marlin and white marlin comprise a single stock within the Atlantic Ocean.

Document SCRS/00/61 reviewed attempts to improve the accuracy of stock assessments of blue marlin (*Makaira nigricans*) and white marlin (*Tetrapturus albidus*) using habitat-based standardization of CPUEs derived from the longline fishery in the Atlantic Ocean. This paper examined the approach of estimating CPUEs under the assumption that blue marlin are restricted to a narrow depth and temperature range.

Sampling of recreational billfish tournaments continued in 1999 along the U.S. east coast, Gulf of Mexico, Bahamas, and U.S. Caribbean. A total of 161 billfish tournaments were sampled in 1999 (compared to 120 tournaments in 1998). This represented 118,488 hours of fishing effort, an increase of about 29,445 hours from the 1998 level. In 1999, sampling accounted for 244 billfish boated (177 blue marlin, 36 white marlin, 30 sailfish, and 0 spearfish); 2,683 released; and 2,341 tagged-and-released. In comparison, in 1998, there were 245 billfish boated (168 blue marlin, 31 white marlin, 46 sailfish, and 0 spearfish); 2,629 released; and 1332 tagged-and-released). Morphometric measurements of billfish landings were also taken in conjunction with the ICCAT Enhanced Research Program for Billfish (ERPB).

The NMFS SEFSC again played a substantial role in the ICCAT Enhanced Research

Program for Billfish in 2000, with SEFSC scientists acting as general coordinator and coordinator for the western Atlantic Ocean. Major accomplishments related to the Billfish Program activities include the following: (1) completion of about 24 at-sea observer trips on Venezuelan longline vessels by October 1999; (2) three of the at-sea observer trips completed were on the larger Korean type vessels that stay out about one month; (3) continuation of the swordfish observer program and biological sampling in Venezuela; (4) continuation of work on shore-based sampling, including billfish tournament sampling in Barbados, St. Maarten, Grenada, Jamaica, Senegal, Cote d'Ivoire, Trinidad and Tobago, and Venezuela; (5) continued efforts to retrieve tag-recaptured billfish (particularly successful in the southeast Caribbean where more than 165 recaptures were reported in 1999); (6) age and growth sampling of billfish continued in 1999; (7) the western Atlantic coordinator acted as chairman of the newly formed ICCAT tag recovery network in 1999; and (8) SEFSC staff made several extended trips to numerous Caribbean locations in 1999 to assist in coordination of the program and collect data; (9) the Western Atlantic coordinator collaborated with VIMS and Bermuda Department of Fisheries on a popup satellite tagging project of blue marlin to evaluate this technology of estimating post-release survival.

Historical tag release and recapture files for Atlantic istiophoridae (*i.e.,* marlins and sailfish) are updated in document SCRS/00/56. The sources of data in this update were limited to the Southeast Fisheries Science Center's Cooperative Tagging Center (CTC), The Billfish Foundation (TBF), and South Carolina's Department of Marine Resources (SCDMR). Data for Istiophoridae are available from 1954 to 2000 for the CTC, from 1990 to 2000 for TBF, and from 1980 to 2000 for SCDMR. The data were presented by agency, gear type, and days at large for Atlantic blue marlin (*Makaira nigricans*), white marlin (*Tetrapturus albidus*), and sailfish (*Istiophorus platypterus*).

Participants in the Southeast Fisheries Science Center’s Cooperative Tagging Center (CTC) tagged and released 2,555 billfishes (including swordfish) in 1999. This represents a decrease of 2% from 1998 levels for the CTC. The Billfish Foundation reported tagging 5,929 billfish for 1999. Among the CTC 1998 billfish releases, there were 963 blue marlin, 451 white marlin, and 938 sailfish.

There were 90 billfish recaptures from the CTC reported in 1999, representing a decrease of 1% from 1998. Among the 1999 CTC billfish recaptures there were 30 blue marlin, 14 white marlin, and 36 sailfish. The ICCAT Enhanced Research Program for Billfish in the western Atlantic Ocean has continued to assist in reporting tag recaptures to improve the quantity and quality of tag recapture reports, particularly from Venezuela, Barbados and Grenada. The Billfish Foundation recovered a total of 204 tagged billfishes in 1999, including 111 blue marlin, 38 white marlin, and 51 sailfish.

There were several noteworthy CTC billfish recaptures during 1999. The longest reported sailfish movement (i.e., minimum straight distance traveled) was 1,160 nautical miles (NM) from a fish released off South Florida (25° 50' N, 80° 0' W) and recaptured off La Guaira, Venezuela

(11° N, 66° 50' West) after 2,289 days at large (6.2 years). The longest straight line distance traveled for a blue marlin recaptured in 1999 was 1,699 NM from a fish released off Louisiana coast (28° N, 91° W) and recaptured off La Guaira, Venezuela (11° N, 66° 50' W). Another blue marlin recaptured in 1999 was at large 9.5 years (3473 days), this fish was released and recaptured off La Guaira, Venezuela. The longest straight line distance traveled by a white marlin in 1999 was 1,603 NM from a fish released off Hatteras, North Carolina (37° N, 74° W) and recaptured off La Guaira, Venezuela, after 1,740 days at large.

A successful pilot study assessing popup satellite tag technology for estimating post-release survival of blue marlin from recreational vessels off Bermuda was reported to the 1999 SCRS (SCRS/99/97). This collaborative research effort, between the Virginia Institute of Marine Science (Dr. John Graves and Dave Kerstetter), the Bermuda Division of Fisheries (Dr. Brian Luckhurst), and the National Marine Fisheries Service (Dr. Eric Prince) was continued in 2000 on longline vessels. Preliminary results from blue marlin tagged from longline vessels are encouraging, with data from 5 out of 7 tagged blue marlin indicating the fish survived the catching and tagging events.

Several researchers are working cooperatively on early life history studies on Atlantic billfishes off Lee Stocking Island in the Bahamas. The original goal of this research was to address some fundamental questions surrounding the biology and ecology of the Atlantic billfishes, with particular emphasis on the earliest life stages inhabiting the surface waters off Lee Stocking Island (LSI). This research program is discussed in more detail in Chapter 3 - Essential Fish Habitat.

2.4.2 Recent Stock Assessment Results

Stock assessments for Atlantic blue marlin and Atlantic white marlin were conducted in 2000. The SCRS suggested that substantial investments in research into the habitat requirements of marlins, as well as the verification of historical catch data, are needed to reduce uncertainties in these assessments.

The new assessment for blue marlin is slightly more optimistic than the 1998 assessment; however, productivity is lower than previously estimated. The total Atlantic stock is approximately 40% of B_{MSY} and the current fishing mortality is approximately four times higher than F_{MSY}. Although blue marlin landings in 1999 were reduced by 29% from 1996 levels, these reductions are not sufficient to rebuild the stock. The SCRS recommended that ICCAT take additional steps to reduce the catch of blue marlin as much as possible.

The 2000 assessment for white marlin was more pessimistic. The total Atlantic stock is estimated at less than 15% of B_{MSY}, and current fishing mortality is estimated to be seven times higher than F_{MSY}. Given that the stock is severely depressed, the SCRS concluded that ICCAT should take steps to reduce the catch of white marlin as much as possible.

The objective of ICCAT resource management is to achieve stock sizes and fishing mortality rates that produce maximum sustainable yield in biomass (MSY). Generally, the model of choice for estimating the condition of the stock relative to MSY has been a surplus-production model. For recent billfish assessments, the surplus-production model has been fitted with the computer program ASPIC. An underlying assumption in such estimation of MSY is that indices of population abundance used in fitting are measured in units of biomass. Because of available data, ICCAT billfish assessments have been conducted using indices of abundance (CPUE) in numbers rather than in biomass. This discrepancy is expected to bias estimates of MSY and related benchmarks. Using simulated fisheries data; the impact of this substitution on estimates of management benchmarks was evaluated. The simulation model was constructed around the life history characteristics of Atlantic blue marlin, and explicitly included sex, size, and age structure on a monthly basis. Growth was sexually dimorphic, with females attaining larger asymptotic mean sizes, and size varied about mean size at age. Annual recruitment was determined from spawning biomass with a Beverton-Holt stock-recruitment function, modified by density-independent stochastic survival. For this evaluation, natural mortality M was assumed to decline from 0.5/yr at first recruitment to 0.1/yr by the age of three, and the slope of the unfished stock-recruitment curve was assumed to be 10. A logistic surplus-production model was fitted to the simulated data sets using ASPIC. Simulations and analyses were performed over the range of estimates of the von Bertalanffy growth parameter k for blue marlin found in the literature. Estimates of management benchmarks differed when numbers- and biomass-based measures of abundance were used in fitting. In summary, biomass-based measures provided generally better fits and perhaps more reliable estimates of benchmarks. However, those summary results are strongly influenced by cases using the lowest published values of k. For other values of k, estimates from numbers-based CPUE tended to be more accurate than those in from biomass-based CPUE; this result presumably stems from offsetting biases. In the absence of conclusive data on billfish growth rates, the importance of this source of error cannot be quantified precisely. Better understanding of growth in these species would allow more precise quantification of likely biases arising from the use of numbers-based abundance indices.

Longbill spearfish and sailfish landings have historically been reported together in annual ICCAT landings statistics. The majority of these landings were most likely sailfish; for 1998 the SCRS reported a 2182 mt catch of sailfish/spearfish, only 17 mt of which was identified as spearfish. The last assessment for West Atlantic sailfish/spearfish was submitted to the SCRS in 1993 and was based on data collected through 1991.

Table 2.4.1 Summary Table for the Status of Atlantic Billfish*

	Atlantic Blue Marlin	Atlantic White Marlin	West Atlantic Sailfish
Age/size at Maturity	2-4 years Females: 193 cm Males: 175 cm	Unknown Females: 155 cm Males: 140 cm	3 years Females: 157 cm Males: 122 cm
Spawning Sites	Tropical and subtropical waters in the summer and fall	Tropical and subtropical waters in the mid- to late spring	Tropical and subtropical waters in the spring through summer
Current Relative Biomass Level *Minimum Stock Size Threshold*	$B_{2000}/B_{MSY} = 0.4$ (0.25-0.6) $0.9B_{MSY}$	$B_{2000}/B_{MSY} = 0.15$ $0.85B_{MSY}$	$B_{92\text{-}96}/B_{MSY} = 0.62$ $0.75B_{MSY}$
Current Relative Fishing Mortality Rate *Maximum Fishing Mortality Threshold*	$F_{99}/F_{MSY} = 4$ (2.6 - 6) $F_{1995}/F_{MSY} = 1.00$	$F_{99}/F_{MSY} = 7$ $F_{1995}/F_{MSY} = 1.00$	$F_{91\text{-}95}/F_{MSY} = 1.4$ $F_{91\text{-}95}/F_{MSY} = 1.00$
Maximum Sustainable Yield	2,000 mt (2000-3000 mt)	1,300 mt (900-2000mt)	700 mt
Current (1999) Yield	3,316 mt	908 mt	546 mt (incomplete)
Current Replacement Yield	1,200 mt (840 - 1600 mt)	< 1999 yield	600 mt
Outlook	Overfished; overfishing is occurring	Overfished; overfishing is occurring	Overfished; overfishing is occurring

*Longbill spearfish are considered Atlantic billfish, but are not included in this table due to the lack of data. The SCRS has yet to complete an assessment of longbill spearfish in the Atlantic and relative biomass and fishing mortality levels are unavailable.

2.4.3 SCRS Advice and Management Actions

In 1997, ICCAT made several recommendations to recover billfish resources throughout the Atlantic Ocean, including reduction of Atlantic blue marlin and white marlin landings by at least 25 percent from 1996 levels, starting in 1998, to be accomplished by 1999; promote the voluntary release of live Atlantic blue marlin and white marlin; and work to improve current monitoring, data collection and reporting in all Atlantic billfish fisheries. A 1998 ICCAT recommendation continued the requirement for a reduced level of marlin landings through 2000. Because commercial landings of Atlantic billfish by U.S.-flagged vessels were prohibited by the 1988 Atlantic Billfish FMP, the 25 percent reduction in blue and white marlin landings affects only recreational anglers in the United States.

In November, 2000, ICCAT made a third recommendation for Atlantic blue marlin and white marlin by developing a two-phase rebuilding program. Phase One measures are to commence in 2001 and apply through 2002, with re-evaluation and adjustment in 2002 for the beginning of Phase Two. During Phase One, the annual amount of blue marlin that can be harvested in years 2001 and 2002 by pelagic longline and purse seine vessels and retained for landing must be no more than 50% of the 1999 landing levels. During Phase One, for white marlin, the annual amount of white marlin that can be harvested by pelagic longline and purse seine vessels and retained for landing must be no more than 33% of the 1999 landing levels. All blue and white marlin brought to pelagic longline and purse seine vessels alive shall be released in a manner that maximizes their survival. These provisions do not apply to marlin that are dead when brought along side of the vessel and that are not sold or entered into commerce. The United States is to monitor the landings of billfish tournaments through scientific observer coverage of at least 5% that includes collection of data on marlin landings from each observed billfish tournament, and endeavor to attain 10% scientific observer coverage on billfish tournament landings by the end of 2002. The United States will also limit its landings to 250 recreationally-caught Atlantic blue and white marlin combined on an annual basis for the period 2001 through 2002.

In the second phase of the rebuilding program, the SCRS will conduct stock assessments of Atlantic blue and white marlins in 2002, and present its evaluation of specific stock recovery scenarios that take into account the new stock assessments, any new information and any re-evaluation of the historical catch and effort time series. Based on SCRS advice, at its 2002 meeting, the Commission will, if necessary, develop and adopt programs to rebuild blue and white marlins to levels that would support MSY. Such rebuilding programs will include a timetable for recovery to a scientifically derived goal, with associated milestones and biological reference points. This objective could be reached through general plans of monitoring of effort and/or time-area closures and/or other measures practical to apply by the various Contracting Parties, Non-Contracting Parties, Entities, and Fishing Entities, taking the specific characteristics of their fisheries into account.

2.5 Stock Assessment Update: ATLANTIC SHARKS

2.5.1 Life History/Species Biology Information

A general discussion of shark characteristics can be found in the HMS FMP (2.4.1). Previously released life history information concerning the thirty-three shark species recently added to the shark management unit can be found in the Essential Fish Habitat section of this report (3.1).

Cooperative research with coastal states to delineate Atlantic and Gulf of Mexico shark nursery grounds is underway through the COASTSPAN program (see also Section 3.1 of the SAFE report). Results identify crucial parturition and nursery grounds for over a dozen species of coastal sharks. Over 1600 sandbar sharks have been tagged in Delaware Bay alone; newborns leave the estuaries in the fall to overwinter in southern nursery grounds. Many surviving juvenile sandbar sharks return to Delaware Bay in the spring. A field study is also underway to explore the reproductive biology of the nurse shark. This shallow water species can serve as a template for understanding elasmobranch breeding and parturition (also see Section 3.1).

A cooperative study with Canadian biologist on the life history of the porbeagle shark continued in 2000 and has elucidated aspects of their reproduction, age and growth, and migration patterns. Results have shown that male porbeagles mature about 174 cm (8 years) and females at 218 cm (13 years). Mating is in the fall and birth of about four oophagous young occurs between March and June after 8 to 9 months gestation.

Tagging studies designed to map nursery areas and migratory patterns of cross-boundary species of sharks are being carried out in Yucatan, Mexico in cooperation with the Institute Nacional de Pesca and Mote Marine Laboratory. A total of 700 juvenile blacktip sharks have been tagged and released in Mexican nurseries, with a recapture rate of 18.2%. Tagging efforts in 1999-2000 focused on areas near the U.S./Mexican border. A workshop of collaborators will be held to assess the last five years of data.

In order to continue to delineate shark distributions and migratory patterns, the Northeast Fisheries Science Center's (NEFSC) Cooperative Shark Tagging Program (CSTP) tagged approximately 5,200 sharks in 2000. Recaptures in the CSTP totaled 562 sharks. The data from this program are maintained on the NEFSC network for analysis.

2.5.2 Most Recent Stock Assessment Data

No new stock assessments were conducted for Atlantic sharks this year, although two assessments - large coastal and small coastal sharks - are scheduled for 2001. The stock assessment information used in the HMS FMP came primarily from the 1998 Shark Evaluation Workshop. Detailed information can be found in Section 2.4 of the FMP. In general, there remains a good deal of uncertainty regarding shark stocks and mortality. Due to most shark species inability to withstand intense exploitation, precautionary approaches were used in adherence with Magnuson-Stevens guidelines.

The University of Florida is continuing an observer program of the directed commercial shark fishery in the Gulf of Mexico under funding from the MARFIN program (Grant Number NA97FF0041). This program is designed to enhance the reliability of management strategies for the shark fishery in the Atlantic. Observers will provide baseline characterization information, by region, on the species composition, relative abundance, and size composition within species for the large coastal and small coastal bottom longline shark fisheries. During the 2000 sampling season at total of 13 shark trips were observed, representing 64 sets (36 large coastal shark sets and 28 small coastal shark sets) yielding 232,470 observed hook hours. The biological data is being processed to identify catch patterns by species and region.

The SCRS Subcommittee on Bycatch has recommended that ICCAT take the lead in conducting stock assessments for Atlantic blue, porbeagle and mako sharks. In anticipation of a pelagic shark assessment taking place in 2002, the subcommittee recommended holding a data preparatory meeting to review all available shark statistics in 2001. Only 25 of the more than 80 countries, entities and fishing entities have provided ICCAT with any information on shark catches. The SCRS has requested that all parties establish adequate data collection systems for collecting catch data, size frequency, and discard information for sharks, and provide this information to ICCAT on an annual basis.

NMFS has recently reached a settlement agreement with Southern Offshore Fishing Association (SOFA) plaintiffs. The terms of the agreement include independent reviews of stock assessments, new stock assessments for large coastal and small coastal sharks, and establishing interim commercial quotas for the large coastal and small coastal shark fisheries at the levels previously established for 1997. In the settlement agreement, NMFS agreed to take action to maintain the 1997 commercial quota levels for large coastal sharks pending an independent review of the 1998 stock assessment, which should be completed in early 2001. NMFS also agreed to take action to maintain the 1997 commercial catch accounting/monitoring procedures and to suspend the commercial minimum size, pending completion of this review. Furthermore, NMFS agreed to take action to maintain the 1997 commercial quota levels for small coastal sharks pending a new stock assessment. New stock assessments for both species groups are expected in 2001.

Table 2.5.1 Summary Table for the Status of Atlantic Sharks

Species	Current Relative Biomass Level	Minimum Stock Size Threshold	Current Fishing Mortality Rate	Maximum Fishing Mortality Threshold	Outlook
Blacktip Shark	N_{98}/N_{MSY}=0.50 (baseline) N_{98}/N_{MSY}=0.48 (alternative)	$0.9B_{MSY}$	F_{97}/F_{MSY} = 3.52 (baseline) F_{97}/F_{MSY} = 3.74 (alternative)	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring.
Sandbar Shark	N_{98}/N_{MSY}=0.58 (baseline) N_{98}/N_{MSY}=0.70 (alternative)	$0.9B_{MSY}$	F_{97}/F_{MSY} = 2.70 (baseline) F_{97}/F_{MSY} = 1.62 (alternative)	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring
Large Coastal Sharks (all species)	N_{98}/N_{MSY}=0.30 (baseline) N_{98}/N_{MSY}=0.36 (alternative)	$0.9B_{MSY}$	F_{97}/F_{MSY} = 6.34 (baseline) F_{97}/F_{MSY} = 6.03 (alternative)	F_{year}/F_{MSY} = 1.00	Overfished; overfishing is occurring
Small Coastal Sharks	B_{91}/B_{MSY} = 1.12	$0.9B_{MSY}$	$F_{86\text{-}91}/F_{MSY}$ = 0.89	F_{year}/F_{MSY} = 1.00	Stock not overfished; overfishing is not occurring
Pelagic Sharks	unknown	unknown	unknown	unknown	unknown

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